Preliminary: For Environmental Work Group Discussion Only

Resource Action Information

Geographic Area	Name of Proposed Resource Action	Description of Proposed Resource Action			E	Engineering/ Bioengineering Solution	Flow Related	Operational Change	Construction	O & M	Comment
LFC-1 (Low Flow Channel)	Structurally modify the Sunset Pumps and Shanghai Bench areas to aid passage of green sturgeon, Sacramento splittail, and other anadromous species.	Under low flow conditions, Shanghai Bench and Sunset Pumps may be impassable for anadromous species due to water velocities in some areas and a vertical height barrier. This Resource Action would provide physical changes to these areas to aid anadromous fish passage.	X		X			+ +	Y		Could be split into two separate projects or joined with LFC-4
LFC-2	Conduct tracking studies to determine timing and movement patterns of sturgeon in Feather River (i.e., field-verify whether passage is limiting).	Under low flow conditions, Shanghai Bench and Sunset Pumps may be impassable for anadromous species due to water velocities in some areas and a vertical height barrier. This Resource Action would provide data on the behavior and movement patterns of adult sturgeon during spawning in Feather River from March to May. Sturgeon arrive in the Feather River in January, February, and March.									**Not a Resource Action** - ongoing FERC Study
LFC-3	Assist in field calibration of sturgeon passage information Feather River from University California-Davis studies (conducted in lab in 2003)	The proposed sturgeon passage study will provide valuable laboratory information on passage requirements for sturgeon that can be applied in Feather River. Included in this study will be an assessment of sturgeon passage potential at multiple flows, which could be applied to limiting passage areas in the Feather River. This Resource Action likely would be implemented in conjunction with tracking studies or with structural improvements to Sunset Pumps or Shanghai Bench areas, which have been shown to be limiting for sturgeon passage during low flow conditions.									**Not a Resource Action** - ongoing FERC Study and South Delta Study
LFC-4	Provide increased, pulse flows to reduce holding time below passage impediments	This Resource Action would provide increased flows during critical upstream passage periods for anadromous fishes in the Feather River. Currently, flows in the low flow reach are maintained at 600 cfs, except during flood events or occasional temporary changes in project operations. The level of flow increase needed to provide sufficient attraction flow or to reduce holding time below passage impediments is not known at this time.		X		X	X		N		Weak data to support concept of pulse flow having benefits for fish passage, engineering fixes to fish passage may be a more direct approach
LFC-5	Installation of a passage structure to aid sturgeon passage during low-flow conditions	A passage structure would be placed at Sunset Pumps and/or Shanghai Bench to facilitate upstream passage of sturgeon and other target fish species into the low flow reach during low flow conditions. The final design and engineering concerns associated with the structure is currently unknown.	X		X			+ +	Y		See also LFC-1 Should be joined woth LFC-1 as a set of alternatives

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LFC-6	Supplement existing armored gravel in low-flow reach with suitable spawning gravel to increase productivity (i.e., # fish produced per unit area).	Spawning gravel would be placed in selected areas in the low flow reach of the Feather River to increase productivity of steelhead and Chinook salmon spawning. This option likely would require continued gravel supplementation over time. Sediment/gravel could be obtained from the Oroville Wildlife Area for eventual placement into the low flow channel. Previous spawning gravel supplementation efforts in other river basins have been successful in providing habitat for salmonids.	X		X			+ +	Y		Need to determine additional options - See LFC-8 and LFC-9
LFC-7	Increase flows in the low flow reach of the Feather River to increase available spawning habitat.	This Resource Action would provide increased flows in the low flow reach of the Feather River during the spawning season of protected or sensitive species to increase spawning habitat utilization.		X		X	X		N		Non-specific - which species will benefit?
LFC-8	Create levee setbacks to increase meandering nature of river and improve gravel composition in critical spawning reaches of the low-flow reach Feather River.	The geomorphology of the low flow reach of the Feather River would be modified by adding levee setbacks. Increasing the meandering nature of the river likely would increase substrate quality in the low flow reach by promoting gravel recruitment, thus increasing production of salmonids or other desired nonnative aquatic species. The exact placement of levee setbacks is uncertain at this time.		X	X			+ + +			**Not a project impact** - Very expensive
LFC-9	Dredge low-flow channel to improve spawning gravel composition.	In areas where armoring has occurred, selected sections of the low flow reach of the Feather River would be dredged with the goal of improving spawning gravel quality. Areas suitable for dredging are uncertain at this time; further information will be obtained after results from SP-G2 have been issued.	X			X		+	Y		Need to define dredging - See LFC-6, LFC-8
LFC-10	Add woody debris to stream reach to increase habitat complexity during rearing.	Large woody debris would be placed or anchored at selected locations in the low flow reach of the Feather River to improve habitat structure. Woody debris provides cover and additional habitat for rearing fish. Currently, large woody debris (LWD) is trapped by the Oroville Reservoir and in flood control bypasses, which is collected and disposed of by the DWR. Geomorphic changes downstream of the dam caused by the project and its operations may have altered and/or reduced inputs of LWD, either through changes in riparian recruitment or alterations in bank stability.	X		X		X	+	Y		Need to review potential legal/liability issues

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LFC-11	Decrease water temperatures in low-flow reach during months when spring-run Chinook salmon are holding in the Feather River.	Lowering water temperatures in the low flow reach of the Feather River likely will require increased flows from the diversion dam or changing the source of water currently used in the low flow reach of the Feather River.	X			X	X		Y	Need modeling output
LFC-12	Create deep pools in low-flow reach of Feather River to provide holding habitat for spring Chinook salmon.	Deep pools would be created in reaches of the Feather River where water temperatures are expected to be cool enough to provide summer habitat for spring-run Chinook salmon.		X		X				No supporting data - ongoing studies to determine when and where spring Chinook over-summer in the low flow channel.
LFC-13	Increase quantity of shallow water rearing habitat in low flow section of Feather River by providing higher flows.	This Resource Action would provide increased flows in the low flow reach of the Feather River to increase available shallow water rearing habitat for protected, sensitive, or other desired fish species.		X		X	X			
LFC-14	Increase regulated flows over baseline condition for the purpose of covering habitats with existing riparian vegetation	This Resource Action would provide increased flows in the low flow reach of the Feather River to increase complexity in shallow water rearing habitat for protected, sensitive, or other desired fish species.		X		X	X			Poorly defined
LFC-15	Increase rearing habitat in side channels via habitat restoration or improvement	This Resource Action would provide habitat restoration or improvement in side channels adjacent to the low flow reach in the Feather River for the purposes of increasing habitat complexity for protected, sensitive, or other desired juvenile fish species.	X		X			+ +	Y	Needs further analysis
LFC-16	Enhance riparian vegetation and trees along banks for shading and increased habitat complexity.	Riparian vegetation and trees would be planted at selected locations in the low flow reach of the Feather River to provide shading and increased habitat complexity for fishes.	X		X			+	Y	See LFC-18
LFC-17	Eliminate non-native invasive plants via various control techniques.	Undesirable non-native plant species in or near the low flow reach of the Feather River would be removed by the most efficient means, especially the species star thistle, ailanthus, and other invasive plant species.		X	X			+	Y	
LFC-18	Enhance or add riparian habitat for threatened or endangered species in the low flow reach of the Feather River.	After data is obtained from relevant study plans (SP-T1, SP-T2, SP-T3/T5, SP-T7, SP-T9), selected habitats in the low flow reach of the Feather River would be enhanced to support the continued presence of western yellow-billed cuckoo, valley elderberry longhorn beetle, or other desired, protected, or sensitive species. Alternatively, riparian habitat could be added in the reach for western yellow-billed cuckoo, valley elderberry longhorn beetle, or other desired, protected, or sensitive species.		+	+				Y	See LFC-16

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LFC-19	Modify recreational use patterns in Feather River reach to minimize impacts to important terrestrial species (exact measures dependent on analysis in upcoming report)	Recreational use patterns in the area of the low flow reach of the Feather River would be regulated, altered, or eliminated to protect or minimize impacts on terrestrial plant and wildlife species.							**Not a Resource Action** - Defer to Recreation Work Group
LFC-20	Operate the Thermalito Complex for multiple uses including the opportunity to minimize temperature of water released to the Feather River through the Thermalito Afterbay Outlet.	There is a conflict to provide warm water for agriculture and cool water to sustain viable fisheries in the Feather River. This proposed Resource Action is to determine operational and/or physical modifications to the Thermalito Complex that will allow both temperature strategies to be achieved.	X	X	X	X	X	X	Y	
LFC-21	Relocate site for hatchery holding ponds or construct new, functional ponds.	The settling ponds associated with the Feather River Fish Hatchery are designed to hold effluent until evaporation occurs, but there is high connectivity between the ponds and the Feather River. Leaching occurs from the settling ponds to the Feather River. The ponds' gravel bottom provides some unknown level of filtration. This Resource Action would construct new settling ponds at the existing location or in a different area that would prevent leaching and/or enhance evaporation.							**Not a Relicensing issue** -- See also LFC-22 -- Could impair flows in the Hatchery Ditch
LFC-22	Line existing settling ponds with impermeable barrier to prevent leaching.	The settling ponds associated with the Feather River Fish Hatchery are designed to hold effluent until evaporation occurs, but there is high connectivity between the ponds and the Feather River. Leaching occurs from the settling ponds to the Feather River. The ponds' gravel bottom provides some unknown level of filtration. This Resource Action would line settling ponds with an impermeable barrier to prevent leaching and/or enhance evaporation.							**Not a Relicensing issue** -- See also LFC-21 -- Could impair flows in the Hatchery Ditch
LFC-23	Post "no swim" or "don't eat fish" warnings anywhere that tissue and/or sediment results suggest problems may be present.	During recent survival/growth studies associated with the Oroville Facilities Relicensing, toxicity tests have indicated "transient" hits during toxicity screening for fish downstream of the Fish Hatchery (no hits were found upstream of the hatchery). This Resource Action would place signing in selected locations in the low flow portion of the Feather River to warn anglers or other river users about potential water quality problems.							**Not a Resource Action**

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LFC-24	Purchase gravel rich areas in low flow reach of Feather River and dedicate for nursery areas for salmonids.	Purchase gravel rich areas in low flow reach of Feather River and dedicate for nursery areas for salmonids. This Resource Action would provide additional rearing locations in the low flow portion of the Feather River to improve salmonid survival.	X		X				Y	Need to clarify this action
LFC-25	Allow spring-run Chinook salmon passage at Feather River Hatchery to prevent merging run timing and redd superimposition.	Spring-run Chinook salmon could be allowed to pass upstream of the Feather River Hatchery to prevent redd superimposition with fall run Chinook salmon. This would require a change in hatchery operations.		X	X		X		Y	Complete a feasibility analysis
LFC-26	Isolate hatchery water intake from Lake Oroville for benefit of reducing in-river water temperatures during periods when the hatchery needs warmer water.	This Resource Action is designed to eliminate the water temperature conflict that occurs when Feather River Hatchery requires warmer water than can be released to the river. Meeting the hatchery water temperature requirement also means that warmer water is released to the river which reduces the quantity and quality of available rearing and adult fish holding habitats in the low flow channel and beyond.		X	X		X	+ + +		**Very expensive** - Water temperature requirements are being met under existing operations, agreements and biological opinions

Key for Construction	**Cost Range**
	+ = low cost
	++ = moderate cost
	+++ = high cost